

in an unloaded condition. Obviously, the power required to drive the orbiting scroll member when the compressor is unloaded (no compression taking place) is considerably less than that required when the compressor is fully loaded. Accordingly, it may be desirable to provide additional control means operative to improve motor efficiency during these periods of reduced load operation thereof.

Such an embodiment is shown schematically in FIG. 45 which comprises a motor compressor 840 having a solenoid valve 842 connected to discharge line 844 via fluid line 846 and a suction line 848 via fluid line 850 and being operative to selectively place a compressor unloading mechanism in fluid communication with either the suction line or discharge line via fluid line 852. Solenoid valve 842 is intended to be controlled by a control module 854 via line 855 in response to system conditions sensed by sensors 856. As thus far described, the system represents a schematic illustration of any of the embodiments described above, it being noted that solenoid valve 842 could be a two way solenoid valve in lieu of the three way solenoid valve arrangement shown. In order to improve efficiency of the driving motor during reduced load operation, a motor control module 858 is also provided which is connected to the compressor motor circuit via line 860 and to control module 854 via line 862. It is contemplated that motor control module 858 will operate in response to a signal from control module 854 indicating that the compressor is being placed in an unloaded operating condition. In response to this signal, motor control module will operate to vary one or more of the compressor motor operating parameters to thereby improve its efficiency during the period of reduced load. Such operating parameters are intended to include any variably controllable factors which affect motor operating efficiency including voltage reduction or varying the running capacitance of the motor for example. Once control module 854 signals motor control module 858 that the compressor is being returned to fully loaded operation, motor control module will then operate to restore the affected operating parameters to maximize motor efficiency under full load operation.

The above described compressor unloading arrangements are particularly well suited to provide a wide range of capacity modulation in a relatively inexpensive and effective manner and to maximize the overall efficiency of the system as compared to prior capacity modulation arrangements. However, under some operating conditions such as those encountered when condenser inlet pressure is at a reduced level, it may be desirable to reduce the compression ratio of the compressor to avoid over-compression of the refrigerant at certain levels of system capacity reduction.

FIG. 46 illustrates a compressor 864 which incorporates both the advantages of a cyclical or pulsed unloading as described above with means for reducing the compression ratio of the compressor so as to thereby increase the ability of the compressor to maximize efficiency under any operating conditions. Compressor 864 is substantially identical to compressor 10 shown in and described with reference to FIG. 1 except as noted below and accordingly like portions thereof are indicated by the same reference numbers primed.

Compressor 864 includes a pair of ports 866, 868 in non-orbiting scroll member 32' which open into compression pockets 870, 872 respectively. Ports 866 and 868 communicate with a passage 874 opening outwardly through the outer periphery of non-orbiting scroll member 32' into the lower area 876 of shell 12' which is at suction pressure. Suitable valve means 878 are provided to selectively control communication of ports 866, 868 with area 876. Preferably, ports 866, 868 will be located in an area such that they will

begin to be in communication with the respective compression pockets prior to the compression pockets being sealed off from the suction fluid supply from area 876.

In operation, when it is determined that a reduction in compressor capacity is desired, a determination will also be made from the system operating conditions if the compressor is operating in an over-compression mode or an under-compression mode. If it is determined that an over-compression mode is present, initial capacity reduction will most efficiently be carried out by opening valve means 878 which will thus place pockets 870, 872 in fluid communication with area 876 of compressor 864 which is at suction pressure. The effect of opening valve 878 is thus seen as reducing the operating length of the wraps as compression does not begin until the respective pockets are closed off from the supply of suction gas. As the volume of the pockets when they are closed off when ports 866, 868 are open to area 876 is less than if ports 866, 868 were closed, the compression ratio of the compressor is reduced. This then will eliminate or at least reduce the level of over-compression. If additional capacity reduction is required after ports 866, 868 have been opened, the cyclic pulsed unloading of compressor 864 may be initiated in the same manner as described above.

If it is initially determined that the compressor is operating either in an under-compression mode or a point between an under and over-compression mode, reducing the compression ratio thereof will only result in decreased efficiency. Therefore, under these conditions, the cyclic pulsed unloading of compressor 864 will be initiated in the same manner as described above while valve means 878 and hence ports 866, 868 remain in a closed position.

In this manner, the overall efficiency of the system may be maintained at a high level regardless of the operating conditions being encountered. It should be noted that while FIG. 46 shows the delayed suction method of capacity modulation incorporated with the embodiment of FIG. 1, it may also be utilized in conjunction with any of the other embodiments disclosed herein. Also, while the delayed suction method of capacity modulation illustrated shows only the use of a single step provided by a single set of ports, it is possible to incorporate multiple steps by providing multiple ports any number of which may be opened depending on the system operating conditions. Also, the specific valving and porting arrangement shown should be considered exemplary only as there exist many different arrangements by which capacity modulation may be achieved via a delayed suction approach. Any number of these known delayed suction approaches may be utilized in place of the arrangement shown. It should also be noted that the arrangement for controlling motor efficiency under reduced load conditions as described with reference to FIG. 45 may also be incorporated into the embodiment of FIG. 46.

While it will be apparent that the preferred embodiments of the invention disclosed are well calculated to provide the advantages and features above stated, it will be appreciated that the invention is susceptible to modification, variation and change without departing from the proper scope or fair meaning of the subjoined claims.

We claim:

1. A scroll-type machine comprising:

a first scroll member having an end plate and a first spiral wrap extending therefrom;

a second scroll member having an end plate and a second spiral wrap extending therefrom, said first and second scroll members being positioned with said first and second spiral wraps interleaved with each other;

a structure for supporting said first and second scroll members for relative orbital movement therebetween whereby said first and second spiral wraps define moving fluid pockets therebetween.

a drive member for driving said first scroll member to effect said relative orbital movement between said first and second scroll members;

said first and second scroll members being movable between a first normal operating relationship in which sealing surfaces of said first and second scroll members are in sealing relationship to close off respective ones of said moving fluid pockets and a second relationship wherein at least one of said sealing surfaces of said first and second scroll members are spaced apart to define a leakage path between said moving fluid pockets; and

a force applying structure independent of said drive member and actuatable to apply a force to one of said scroll members to move said scroll member between said first relationship in which said scroll machine operates at substantially full capacity and said second relationship in which said scroll machine operates at substantially zero capacity while said drive member continues to operate whereby the capacity of said compressor is modulated.

2. A scroll-type machine as set forth in claim 1 wherein said force applying structure is operated in a time pulsed manner to modulate the capacity of said compressor.

3. A scroll-type machine as set forth in claim 2 wherein said force applying structure includes an actuator directly connected to the other of said first and second scrolls, said actuator being operative to move said other of said first and second scrolls between said first and second operational relationships.

4. A scroll-type machine as set forth in claim 3 wherein said actuator is a fluid operated piston and cylinder.

5. A scroll-type machine as set forth in claim 3 wherein said actuator is a solenoid device.

6. A scroll-type machine as set forth in claim 2 wherein said scroll-type machine includes a discharge flow path for conducting compressed fluid from said compressor and a check valve located within said flow path to prevent reverse flow of said compressed fluid.

7. A scroll-type machine as set forth in claim 3 wherein said actuator is electrically operated.

8. A scroll-type machine as set forth in claim 1 further comprising a control module operatively connected to said force applying structure and at least one sensor, said control module being operative to actuate said force applying structure in response to a signal from said sensor.

9. A scroll-type machine as set forth in claim 1 wherein said force applying structure includes a fluid pressure chamber operative to apply said force to said one of said first and second scroll members.

10. A scroll-type machine as set forth in claim 9 wherein said fluid pressure chamber operates to apply a force to move said one of said first and second scroll members.

11. A scroll-type machine as set forth in claim 10 wherein said force acts in an axial direction.

12. A scroll-type machine as set forth in claim 11 wherein said force applying structure includes a passage for supplying a pressurized fluid from said compressor to said pressure chamber.

13. A scroll-type machine as set forth in claim 12 further including a valve for controlling flow through said passage, said valve being operative to vent said pressurized fluid from said pressure chamber to thereby enable said first and second scrolls to move between said first and second relationship.

14. A scroll-type machine as set forth in claim 13 wherein said valve is a solenoid operated valve.

15. A scroll-type machine as set forth in claim 13 wherein said valve is fluid pressure operated.

16. A scroll-type machine as set forth in claim 12 wherein said force applying means includes a passage for venting said pressurized fluid from said chamber.

17. A scroll-type machine as set forth in claim 16 wherein said pressurized fluid acts on said one of said first and second scrolls.

18. A scroll-type machine as set forth in claim 17 wherein said pressurized fluid operates to urge said one of said first and second scrolls into said first operating relationship.

19. A scroll-type machine as set forth in claim 17 wherein said pressurized fluid operates to urge said one of said first and second scrolls into said second operating relationship.

20. A scroll-type machine as set forth in claim 16 wherein said pressurized fluid acts on the other of said first and second scroll members.

21. A scroll-type machine as set forth in claim 10 wherein said force acts in a radial direction.

22. A scroll-type machine as set forth in claim 21 wherein said force operates to reduce the radius of relative orbital movement.

23. A scroll-type machine as set forth in claim 1 wherein said first scroll member rotates about a first axis and said second scroll member rotates about a second axis offset from said first axis.

24. A scroll-type machine as set forth in claim 1 wherein said second scroll member is non-rotatably axially movably supported on said fixed support structure.

25. A scroll-type machine as set forth in claim 1 wherein said force applying structure includes an actuator directly connected to the other of said first and second scrolls, said actuator being operative to move said other of said first and second scroll members between said first and second operational relationships.

26. A scroll-type machine as set forth in claim 1 wherein said force applying structure utilizes fluid from said moving fluid pockets to apply said force.

27. A scroll-type machine comprising:

- a first scroll member having an end plate and a first spiral wrap extending therefrom;
- a second scroll member having an end plate and a second spiral wrap extending therefrom, said first and second scroll members being positioned with said first and second spiral wraps interleaved with each other;
- a support structure for supporting said first and second scroll members for relative orbital movement therebetween whereby said first and second spiral wraps define moving fluid pockets therebetween;
- a drive shaft rotatably drivingly coupled to said first scroll member to effect said relative orbital movement between said first and second scroll members;
- a drive motor connected to said drive shaft;
- control means associated with said motor;
- said first and second scroll members being movable between a first normal operating relationship in which sealing surfaces of said first and second scroll members are in sealing relationship to close off respective ones of said moving fluid pockets and a second relationship wherein at least one of said sealing surfaces of said first and second scroll members are spaced apart to define a leakage path between said moving fluid pockets; and
- a force applying structure independent of said drive shaft and actuatable to apply a force to one of said scroll

members to move said scroll members between said first relationship in which said scroll machine operates at substantially full capacity and said second relationship in which said scroll machine operates at substantially zero capacity while said drive shaft continues to rotate whereby the capacity of said compressor is modulated;

said control means being operative to control an operating parameter of said motor when said first and second scroll members are in said second relationship to thereby improve the operating efficiency of said motor.

28. A scroll-type machine as set forth in claim 27 wherein said operating parameter is the voltage applied to said motor.

29. A scroll-type machine as set forth in claim 27 wherein said operating parameter is the running capacitance of said motor.

30. A scroll-type machine comprising:

a first scroll member having a first end plate and a first spiral wrap provided thereon;

a second scroll member having a second end plate and a second spiral wrap provided thereon, said first and second scroll members being positioned for relative orbital movement with said first and second spiral wraps interleaved with each other to define moving fluid pockets;

a drive shaft drivably connected to said first scroll member.

a power source operative to rotatably drive said drive shaft to thereby effect relative orbital movement between said first and second scroll members; and

force applying structure independent of said drive shaft for effecting axial movement of one of said first and second scroll members between a first relationship in which said first and second scroll members are in a sealing relationship to thereby define moving fluid pockets whereby said scroll-type machine operates at substantially full capacity and a second relationship in which said first and second scroll members are axially separated sufficiently to place said fluid pockets in communication with each other whereby said scroll-type machine operates at substantially zero capacity so that the capacity of said compressor is modulated.

31. A scroll-type machine as set forth in claim 30 wherein said drive shaft continues to drive said first scroll member during axial movement of said one scroll member.

32. A scroll-type machine as set forth in claim 30 wherein said force applying structure includes a fluid pressure chamber and a first passage for placing said chamber in communication with a source of pressurized fluid, said pressurized fluid operating to exert a force on said one of said first and second scroll members to urge said one scroll member into one of said first and second relationships.

33. A scroll-type machine as set forth in claim 32 wherein said force applying structure includes a second fluid passage for venting pressurized fluid from said chamber.

34. A scroll-type machine as set forth in claim 33 wherein said force applying structure includes a valve for controlling flow of pressurized fluid from said chamber.

35. A scroll-type machine as set forth in claim 34 wherein said force from said pressurized fluid acts to urge said one scroll into said second relationship.

36. A scroll-type machine as set forth in claim 35 wherein said pressurized fluid is at substantially discharge pressure.

37. A scroll-type machine as set forth in claim 36 wherein said force from said pressurized fluid acts on said second scroll member.

38. A scroll-type machine as set forth in claim 37 wherein said first passage extends between said chamber and said valve, said second passage extends between said valve and an area at substantially suction pressure and a third fluid passage extends between said valve and a supply of pressurized fluid at substantially discharge pressure, said valve being operative to selectively place said first passage in fluid communication with said second passage and said third passage.

39. A scroll-type machine as set forth in claim 38 wherein said chamber is defined in part by said second scroll member and in part by a second member.

40. A scroll-type machine as set forth in claim 39 wherein said second member defines in part a second chamber, said machine including a fourth passage operative to supply a pressurized fluid to said second chamber to thereby urge said second scroll member axially into said first relationship.

41. A scroll-type machine as set forth in claim 40 wherein said second member is rotatably driven by said drive shaft.

42. A scroll-type machine as set forth in claim 40 wherein said second member is stationary.

43. A scroll-type machine as set forth in claim 39 wherein said second member includes a stop surface to limit axial movement of said second scroll member.

44. A scroll-type machine as set forth in claim 33 wherein said force applying structure further includes a valve operative to control fluid flow through said first and second passages.

45. A scroll-type machine as set forth in claim 44 wherein said chamber is defined in part by said second scroll member and a second member.

46. A scroll-type machine as set forth in claim 45 wherein said first and second passages are provided in said second member.

47. A scroll-type machine as set forth in claim 46 wherein said valve is movably disposed in said second member and includes an actuator for moving said valve to a position in which said chamber is placed in fluid communication with a low pressure area of said machine via said second passage and a second position in which said chamber is placed in fluid communication with a source of high pressure fluid.

48. A scroll-type machine as set forth in claim 47 wherein said actuator is electrically operated.

49. A scroll-type machine as set forth in claim 48 wherein said actuator is a solenoid device.

50. A scroll-type machine as set forth in claim 47 wherein said actuator is operated by pressurized fluid.

51. A scroll-type machine as set forth in claim 32 wherein said first passage is provided in the end plate of said one of said scrolls.

52. A scroll-type machine as set forth in claim 51 wherein said first passage places said chamber in fluid communication with a pressurized fluid to thereby urge said one scroll member into said first relationship.

53. A scroll-type machine as set forth in claim 51 further comprising a second passage extending between said chamber and a low pressure area of said machine, and a valve disposed along said second passage to control fluid flow therethrough.

54. A scroll-type machine as set forth in claim 53 wherein said one scroll member is said first scroll member and said chamber is defined by said first end plate and a main bearing housing.

55. A scroll-type machine as set forth in claim 54 further comprising an annular seal between said main bearing housing and said first end plate.

56. A scroll-type machine as set forth in claim 55 further comprising springs extending between said main bearing

housing and said first end plate to aid in urging said first scroll member into said first relationship.

57. A scroll-type machine as set forth in claim 30 wherein said force applying structure is directly connected to said one of said scroll members.

58. A scroll-type machine as set forth in claim 57 wherein said force applying structure includes an actuator operative to axially reciprocate a shaft, one end of said shaft being secured to said one scroll member.

59. A scroll-type machine as set forth in claim 58 wherein said actuator is electrically operated.

60. A scroll-type machine as set forth in claim 58 wherein said actuator is operated by fluid pressure.

61. A scroll-type machine as set forth in claim 30 wherein said force applying structure is operated to allow movement of said one of said first and second scroll members into said first relationship for a first predetermined time period and to allow movement of said one scroll member into said second relationship for a second predetermined period of time.

62. A scroll-type machine as set forth in claim 61 further comprising sensors for sensing operating conditions and providing a signal indicative thereof to a control module, said control module being operative to vary the capacity of said scroll machine by controlling the duration of said first and second time periods in accordance with said sensed conditions.

63. A scroll-type machine as set forth in claim 61 wherein said first predetermined time period is fixed and said second predetermined time period is varied.

64. A scroll-type machine as set forth in claim 61 wherein said first predetermined time period is varied and said second predetermined time period is fixed.

65. A scroll-type machine as set forth in claim 61 wherein the sum of said first and second time periods is a constant.

66. A scroll-type machine as set forth in claim 30 wherein said force applying structure utilizes fluid from said moving fluid pockets to apply said force.

67. A scroll-type machine comprising:

- a first scroll member having a first end plate and a first spiral wrap provided thereon;
- a second scroll member having a second end plate and a second spiral wrap provided thereon, said first and second scroll members being positioned for relative orbital movement with said first and second spiral wraps interleaved with each other to define moving fluid pockets;
- a drive shaft drivingly connected to said first scroll member;
- a driving motor operative to rotatably drive said drive shaft to thereby effect relative orbital movement between said first and second scroll members;
- a motor controller operatively connected to said motor; force applying structure for effecting axial movement of one of said first and second scroll members between a first relationship in which said first and second scroll members are in a sealing relationship to thereby define moving fluid pockets whereby said scroll machine operates at substantially full capacity and a second relationship in which said first and second scroll members are axially separated sufficiently to place said fluid pockets in communication with each other whereby said scroll machine operates at substantially zero capacity so that the capacity of said compressor is modulated, said force applying structure being operated to allow movement of said one of said first and second scroll members into said first relationship for a first

predetermined time period and to allow movement of said one scroll member into said second relationship for a second predetermined period of time; and

sensors for sensing operating conditions and providing a signal indicative thereof to a control module, said control module being operative to vary the capacity of said scroll machine by controlling the duration of said first and second predetermined time periods in accordance with said sensed conditions;

said motor controller being operative to vary at least one operating parameter of said motor in response to a signal from said control module that said first and second scroll members are in said second relationship to thereby improve the operating efficiency of said motor during said second predetermined time periods.

68. A scroll-type compressor comprising:

- a hermetic shell having a partition separating the interior thereof into a discharge chamber and a suction chamber;
- a suction line opening into said suction chamber;
- a discharge line opening out of said discharge chamber;
- a bearing housing supported within said shell;
- a first scroll member disposed within said suction chamber and having a first end plate and a first spiral wrap provided on said end plate, said first scroll member being supported on said bearing housing;
- a second scroll member disposed within said suction chamber and having a second end plate and a second spiral wrap provided thereon, said first and second scrolls being interleaved so as to define moving fluid pockets therebetween which decrease in size as they move from a radially outer position to a radially inner position, said second scroll member being axially movably secured to said bearing housing, said second scroll member including a central discharge port and an annular cavity surrounding said discharge port;
- a drive shaft drivingly coupled to said first scroll member;
- a flanged member secured to said partition and including a portion extending into said cavity and separating said cavity into a biasing chamber and a separating chamber;
- a first passage in said second end plate for placing said biasing chamber in communication with a fluid pocket at a pressure between suction and discharge to thereby axially bias said second scroll member into sealing relationship with said first scroll member;
- a second passage for selectively placing said separating chamber in communication with fluid at discharge pressure to thereby axially move said second scroll member away from said first scroll member to unload said compressor; and
- a valve for controlling fluid flow through said second passage.

69. A scroll-type compressor as set forth in claim 68 wherein said valve is actuated in a time pulsed manner to cyclically load and unload said compressor whereby the capacity of said compressor may be modulated between substantially zero and one hundred percent.

70. A scroll-type compressor as set forth in claim 69 further including a third fluid passage extending from said valve and to an area of at substantially suction pressure, said valve being operable to a position to place said separating chamber in fluid communication with said area at suction pressure to vent said separating chamber.

71. A scroll-type compressor as set forth in claim 70 wherein said valve is positioned within said flanged member.

72. A scroll-type compressor as set forth in claim 69 wherein said drive shaft extends outwardly of said shell.

73. A scroll-type compressor comprising:

- an outer shell;
- a bearing housing supported within said outer shell;
- a first scroll member movably supported on said bearing housing and having a first end plate and a first spiral wrap positioned thereon;
- a second scroll member secured to said bearing housing and having a second end plate and a second spiral wrap provided thereon, said first and second scroll members being positioned in interleaved relationship;
- a drive shaft rotatably supported by said bearing housing and operative to drive said first scroll member in orbital movement whereby said first and second scroll members define moving fluid pockets which decrease in size as they move radially inwardly;
- a suction line for supplying fluid at suction pressure to said compressor;
- a discharge line for discharging compressed fluid at discharge pressure from said compressor;
- a biasing chamber defined between said first end plate and said bearing housing;
- a first passage in said first end plate for supplying a pressurized fluid to said biasing chamber to thereby bias said first scroll member into sealing relationship with said second scroll member;
- a second passage communicating between said biasing chamber and an area at suction pressure to vent pressurized fluid from said biasing chamber whereby fluid pressure within said moving fluid pockets will move said first scroll member axially away from said second scroll member thereby unloading said compressor;
- a valve in said second passage to control fluid flow therethrough to thereby selectively control unloading of said compressor and modulate the capacity thereof.

74. A scroll-type compressor as set forth in claim 73 wherein the interior of said shell is at discharge pressure.

75. A scroll-type compressor as set forth in claim 74 further comprising an annular seal extending between said bearing housing and said first end plate to seal said biasing chamber from the interior of said shell.

76. A scroll-type compressor as set forth in claim 75 further comprising a second annular seal extending between said bearing housing and said first end plate, said biasing chamber being defined between said annular and second annular seals.

77. A scroll-type compressor comprising:

- an outer shell;
- a bearing housing supported within said outer shell;
- a first scroll member movably supported on said bearing housing and having a first end plate and a first spiral wrap positioned thereon;
- a second scroll member secured to said bearing housing and having a second end plate and a second spiral wrap provided thereon, said first and second scroll members being positioned in interleaved relationship;
- a drive shaft rotatably supported by said bearing housing and operative to drive said first scroll member in orbital movement whereby said first and second scroll members define moving fluid pockets which decrease in size as they move radially inwardly;
- a suction line for supplying fluid at suction pressure to said compressor;

a discharge line for discharging compressed fluid at discharge pressure from said compressor;

a biasing chamber defined between said first end plate and said bearing housing;

a first passage in said first end plate for supplying a pressurized fluid to said biasing chamber to thereby bias said first scroll member into sealing relationship with said second scroll member;

said second scroll member including an annular cavity; a piston movably disposed within said cavity and operative to move said first scroll member axially away from said second scroll member;

a second passage for supplying pressurized fluid to said annular cavity to move said piston;

valve means for selectively controlling fluid flow through said second passage to thereby selectively unload said compressor.

78. A scroll-type compressor as set forth in claim 77 further including a third fluid passage connected between said valve and an area of said compressor at suction pressure, said valve being operable to vent said annular cavity to thereby enable said biasing chamber to move said first scroll member into sealing engagement with said second scroll member.

79. A scroll-type machine comprising:

- a first scroll member having an end plate and a first spiral wrap upstanding therefrom;
- a second scroll member having an end plate and a second spiral wrap upstanding therefrom, said first and second scroll members being positioned with said first and second spiral wraps interleaved with each other;
- a motor drivably connected to said first scroll member;
- a structure for supporting said first and second scroll members for relative orbital movement therebetween whereby said first and second spiral wraps define moving fluid pockets;
- a capacity modulation device for reducing the capacity of said compressor from a predetermined maximum and to provide a signal indicative of said capacity reduction; and
- a motor controller operative to vary an operating parameter of said motor in response to said signal from said capacity modulation device to thereby improve the efficiency of said motor while said capacity of said compressor is reduced.

80. A scroll-type machine as set forth in claim 79 wherein said capacity modulation device is operated in a time pulsed manner to vary the capacity of said compressor.

81. A scroll-type machine as set forth in claim 80 wherein said capacity modulation device includes

- a force applying structure actuable to apply a force to one of said first and second scroll members to effect relative movement between a first relationship in which sealing surfaces of said first and second scroll members are in sealing relationship to close off respective ones of said moving fluid pockets and a second relationship in which at least one of said sealing surfaces of said first and second scroll members are spaced apart to define a leakage path between said moving fluid pockets.

82. A scroll-type machine as set forth in claim 79 wherein said motor controller operates to vary the voltage applied to said motor.

83. A scroll-type machine as set forth in claim 79 wherein said motor controller operates to vary the load applied to said motor controller.

84. A scroll-type machine comprising:

- a first scroll member having an end plate and a first spiral wrap extending therefrom;
- a second scroll member having an end plate and a second spiral wrap extending therefrom, said first and second scroll members being positioned with said first and second spiral wraps interleaved with each other;
- a structure for supporting said first and second scroll members for relative orbital movement therebetween whereby said first and second spiral wraps define moving fluid pockets therebetween which decrease in size as they move to a radially inner position to compress a fluid therein;
- a drive shaft rotatably drivingly coupled to said first scroll member to effect said relative orbital movement between said first and second scroll members;
- said first and second scroll members being movable between a first normal operating relationship in which sealing surfaces of said first and second scroll members are in sealing relationship to close off respective ones of said moving fluid pockets and a second relationship wherein at least one of said sealing surfaces of said first and second scroll members are spaced apart to define a leakage path between said moving fluid pockets; and
- a force applying structure using said compressed fluid from said fluid pockets to apply a force to one of said scroll members to move said scroll members between said first relationship in which said scroll machine operates at substantially full capacity and said second relationship in which said scroll machine operates at substantially zero capacity while said drive shaft continues to rotate whereby the capacity of said compressor is modulated.

85. A scroll-type machine as set forth in claim 84 wherein said force applying structure is operated in a time pulsed manner to modulate the capacity of said compressor.

86. A scroll-type machine as set forth in claim 85 wherein said scroll-type machine includes a discharge flow path for conducting compressed fluid from said compressor and a check valve located within said flow path to prevent reverse flow of said compressed fluid.

87. A scroll-type machine as set forth in claim 85 wherein said scroll machine includes a driving motor and a motor controller operatively connected to said motor, said motor controller being operative to vary at least one operating parameter of said motor in response to a signal from said control module that said first and second scroll members are in said second relationship to thereby improve the operating efficiency of said motor during said second predetermined time periods.

88. A scroll-type machine as set forth in claim 84 wherein said first scroll member rotates about a first axis and said second scroll member rotates about a second axis radially offset from said first axis.

89. A scroll-type machine comprising:

- a first scroll member having an end plate and a first spiral wrap extending therefrom;
- a second scroll member having an end plate and a second spiral wrap extending therefrom, said first and second scroll members being positioned with said first and second spiral wraps interleaved with each other;
- a support structure for supporting said first and second scroll members for rotational movement about radially offset axis;
- a drive member for rotatably driving said first scroll member to effect relative orbital movement between

said first and second scroll members whereby said first and second spiral wraps define moving fluid pockets therebetween;

- said first and second scroll members being movable between a first normal operating relationship in which sealing surfaces of said first and second scroll members are in sealing relationship to close off respective ones of said moving fluid pockets and a second relationship wherein at least one of said sealing surfaces of said first and second scroll members are spaced apart to define a leakage path between said moving fluid pockets; and
- a force applying structure independent of said drive member and actuatable to apply a force to one of said scroll members to move said scroll members between said first relationship in which said scroll machine operates at substantially full capacity and said second relationship in which said scroll machine operates at substantially zero capacity while said drive shaft continues to rotate whereby the capacity of said compressor is modulated.

90. A scroll-type machine comprising:

- a first scroll member having an end plate and a first spiral wrap extending therefrom;
- a second scroll member having an end plate and a second spiral wrap extending therefrom, said first and second scroll members being positioned with said first and second spiral wraps interleaved with each other;
- a fixed support structure for supporting said first and second scroll members for relative orbital movement therebetween whereby said first and second spiral wraps define moving fluid pockets therebetween which decrease in size as they move from a radially outer position to a radially inner position to compress a fluid in said pockets;
- a drive shaft rotatably drivingly coupled to said first scroll member to effect said relative orbital movement between said first and second scroll members;
- said first and second scroll members being movable between a first normal operating relationship in which sealing surfaces of said first and second scroll members are in sealing relationship to close off respective ones of said moving fluid pockets and a second relationship wherein at least one of said sealing surfaces of said first and second scroll members are spaced apart to define a leakage path between said moving fluid pockets;
- a force applying structure utilizing said compressed fluid from said moving fluid pockets to apply a force to one of said scroll members to move said scroll members between said first relationship in which said scroll machine operates at substantially full capacity and said second relationship in which said scroll machine operates at substantially zero capacity while said drive shaft continues to rotate whereby the capacity of said compressor is modulated, and
- said force applying structure including a biasing chamber,

a fluid passage for providing said compressed fluid to said biasing chamber, a valve for selectively controlling fluid flow through said passage and a vent passage for venting pressurized fluid from said biasing chamber.

91. A scroll-type machine as set forth in claim 84 wherein said vent passage is in open communication to a low pressure area of said scroll-type machine.

92. A scroll-type machine as set forth in claim 84 wherein said valve operates in a time pulsed manner to cyclically pressurize said biasing chamber.

93. A scroll-type machine as set forth in claim 86 wherein said biasing chamber operates to bias said one scroll toward said second position.

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94. A scroll-type machine as set forth in claim 87 further comprising a second biasing chamber and a second fluid passage for providing fluid from said moving fluid pockets to said second biasing chamber.

95. A scroll-type machine as set forth in claim 88 wherein said second biasing chamber operates to bias said one scroll member toward said first position.

96. A scroll-type machine comprising:

a first scroll member having an end plate and a first spiral wrap extending therefrom;

a second scroll member having an end plate and a second spiral wrap extending therefrom, said first and second scroll members being positioned with said first and second spiral wraps interleaved with each other;

a drive member for driving said first scroll member to effect said relative orbital movement between said first and second scroll members; and

a force applying structure independent of said drive member and actuatable to apply a force to one of said scroll members to move said scroll members between a first relationship in which said scroll machine operates at substantially full capacity and a second relationship in which said scroll machine operates at substantially zero capacity while said drive shaft continues to rotate whereby the capacity of said compressor is modulated.

97. A scroll-type machine comprising:

a first scroll member having an end plate and a first spiral wrap extending therefrom;

a second scroll member having an end plate and a second spiral wrap extending therefrom, said first and second scroll members being positioned with said first and second spiral wraps interleaved with each other;

a drive member for driving said first scroll member to effect said relative orbital movement between said first and second scroll members; and

a force applying structure independent of said drive member and actuatable to apply a force to one of said scroll members in a time pulsed manner to move said scroll members between a first relationship in which said scroll machine operates at a first capacity and a second relationship in which said scroll machine operates at reduced capacity while said drive member continues to rotate whereby the capacity of said compressor is modulated.

98. A scroll-type machine as set forth in claim 97 further comprising:

a drive motor for driving said drive member;

a control associated with said drive motor, said control being operative to control an operating parameter of said motor when said first and second scroll members are in said second relationship to thereby improve the operating efficiency of said motor.

99. A scroll-type machine as set forth in claim 97 wherein said force applying structure is operated to allow movement

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of said one of said first and second scroll members into said first relationship for a first predetermined time period and to allow movement of said one scroll member into said second relationship for a second predetermined period of time.

100. A scroll-type machine as set forth in claim 99 further comprising sensors for sensing operating conditions and providing a signal indicative thereof to a control module, said control module being operative to vary the capacity of said scroll machine by controlling the duration of said first and second time periods in accordance with said sensed conditions.

101. A scroll-type machine comprising:

a first scroll member having an end plate and a first spiral wrap extending therefrom;

a second scroll member having an end plate and a second spiral wrap extending therefrom, said first and second scroll members being positioned with said first and second spiral wraps interleaved with each other;

a structure for supporting said first and second scroll members for relative orbital movement therebetween whereby said first and second spiral wraps define moving fluid pockets therebetween;

a drive member for driving said first scroll member to effect said relative orbital movement between said first and second scroll members;

said first and second scroll members being movable between a first normal operating relationship in which sealing surfaces of said first and second scroll members are in sealing relationship to close off respective ones of said moving fluid pockets and a second relationship wherein at least one of said sealing surfaces of said first and second scroll members are spaced apart to define a leakage path between said moving fluid pockets;

a force applying structure actuatable in a time pulsed manner to apply a force to one of said scroll members to move said scroll member between said first relationship in which said scroll machine operates at substantially full capacity and said second relationship in which said scroll machine operates at substantially zero capacity while said drive member continues to operate; and

control means to control the ratio of the time said one scroll member is in said first relationship to the time said one scroll member is in said second relationship whereby the capacity of said compressor is modulated.

102. A scroll-type machine as set forth in claim 101 wherein said control means controls the time said one scroll member is in said first relationship and the time said scroll member is in said second relationship in response to operating conditions in a manner to maximize the efficiency of said compressor in addition to modulating the capacity of said compressor.

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